Mapping the impacts of climate change on vector-borne diseases: application to Orbiviruses

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Climate impacts vector-borne disease transmission through a complex interplay of influences on all the actors involved: the vector, the host and the pathogen. Climate change can lead to shifts in disease distribution, exposing naive host populations and potentially leading to sanitary crisis. Assessing the effects of climate change on diseases is necessary in order to better prepare and mitigate such impacts.

The basic reproduction ratio (R_0) measures the number of secondary cases arising from the introduction of one infected host in a susceptible population. It reflects the risk of transmission if the pathogen is introduced. Some of its parameters such as the vector biting rate, the vector mortality rate, the extrinsic incubation period and, the vector to host ratio exhibit a strong climatic dependence. Linking these parameters with climate observations or simulations allows mapping of past and future R_0.

We illustrate this approach by applying it to two diseases caused by Orbiviruses transmitted by *Culicoides* biting midges: bluetongue and African horse sickness. We map R_0 anomalies for Europe for past (1961 to 2010) and future (2011 to 2050) periods and assess the uncertainty of the results presented. This approach also enables a better understanding of the underlying mechanisms involved in transmission risk increase or decrease.

We discuss (i) the conditions necessary to apply this approach to other diseases, (ii) its strengths and limits, and (iii) propose entomological, epidemiological and climatic studies to further improve the approach.